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(12) UK Patent Application (19) GB (11) 2 225 543 (13) A

(43) Date of A publication 06.06.1990

(21) Application No 8925967.5

(22) Date of filing 16.11.1989

(30) Priority data
(31) 8826828 (32) 16.11.1988 (33) GB

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(51) INT CL[5]
B01D 27/06

(52) UK CL (Edition K)
B1T TDGA
U1S S1272 S1289 S1738

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(58) Field of search
UK CL (Edition J) B1D DDGA DDHA DDTA DEAA DEBA, B1T TDGA TDHA TDTA TEAA TEBA
INT CL[4] B01D 27/06

55/521

(54) Air filter element

(57) A HEPA filter element of generally flat but pleated form is reinforced along the 'fold' lines, either by applying adhesive beads to a previously folded filter sheet or by making up the element from separate filter sheets 15 which are then bonded together, either directly (Fig. 1) or via moulded edge strips 16. The sheets may be paper or various other sheet materials. The pleats may be supported by spacers, which may be integral with each other and with edge strips 16.

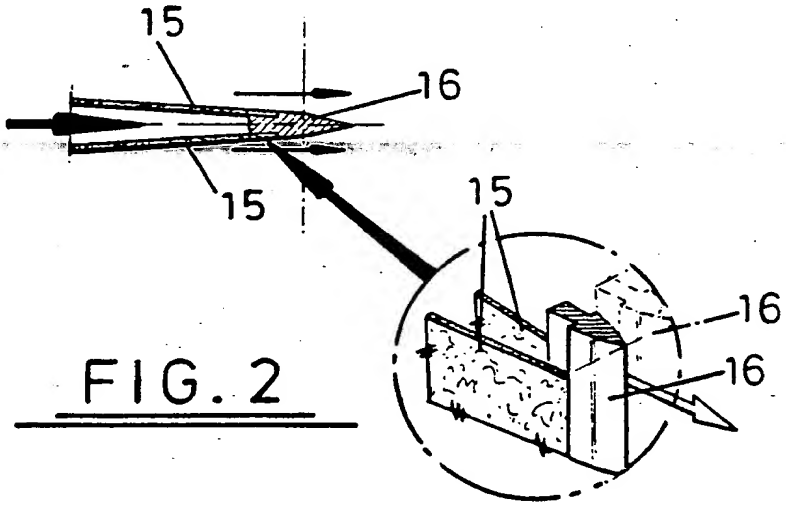

FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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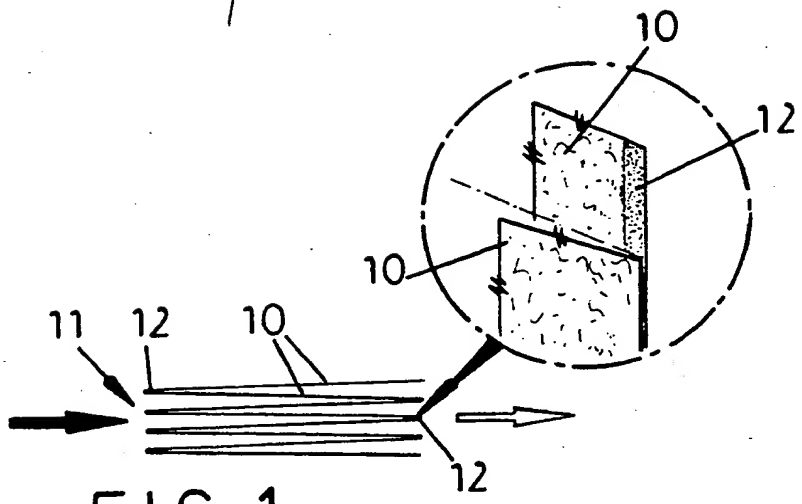

FIG. 1

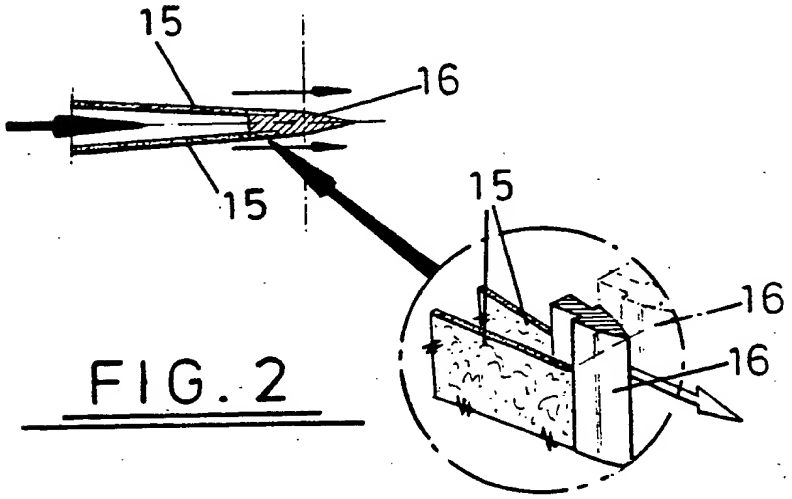

FIG. 2

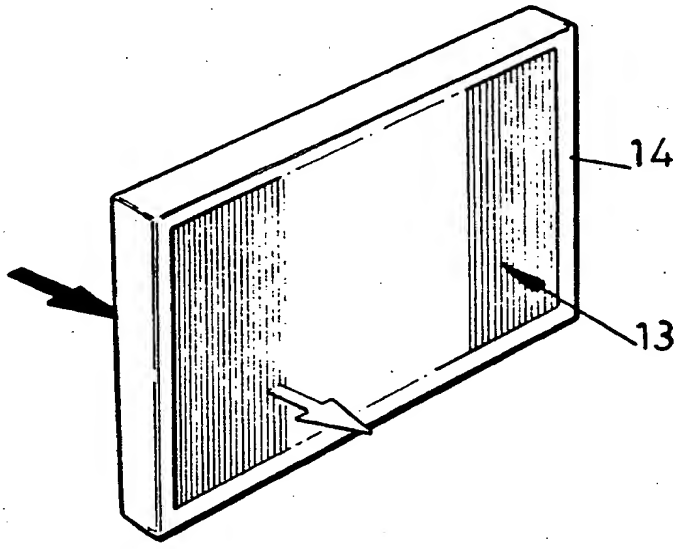

FIG. 3

FILTERS

This invention relates to filters and to a method of manufacturing same.

The invention is especially but not exclusively concerned with HEPA (high efficiency particulate air) filters as used in air filtration equipment employed in environments where airborne contamination and cross infection must be reduced to an absolute minimum, such, for example, as in clean rooms or laminar flow cabinets on microbiological safety cabinets.

For the avoidance of doubt, filters according to the present invention are applicable for use in any environmental situation where airborne contamination is undesirable.

Reference will be made hereinafter and in the claims to "paper" being the filtering medium but the term "paper" is to be construed as including any suitable filtering medium. Examples of suitable filtering media are glass fibre, plastics or textile materials, woven or non-woven materials.

A conventional method of forming a paper filter, especially a HEPA filter (and for convenience reference (non-limitative) will hereinafter be made to same), is to fold the filter paper into a multiplicity of side-by-side pleats, mount the pleated filter paper mass in a supporting frame and secure using adhesive. Spacers can be mounted between adjacent pleats.

There are at present two forms of HEPA filters namely a standard HEPA filter and what is known as a "minipleat" HEPA filter. The latter is much more compact and dense (more pleats per square metre for example) than the standard HEPA filter and consequently a dimensionally smaller "minipleat" HEPA filter can provide the same filtration capacity as a larger standard HEPA filter.

These known pleated HEPA filters are produced manually or by fairly complex folding machinery so that they are

expensive to manufacture.

Constructionally, HEPA filters, due to the fragile nature of the material (paper), are weakest at the folds where there is always a risk of the folds fracturing during manufacture or leaking during operation with consequent deterioration of the air cleanliness which may, depending upon the environmental situation involved, be dangerous to persons working in the environment and animals being used therein.

In an effort to overcome this weakness the fold regions are usually made more radiussed than is desirable thus rendering these regions less aerodynamically efficient with consequent poor air flow efficiency and a tendency for faster clogging to occur.

It is an object of the present invention to provide a filter, especially but not exclusively a HEPA filter, which obviates or mitigates the aforesaid disadvantages.

According to an aspect of the present invention there is provided a filter, especially but not exclusively a HEPA filter, comprising a multiplicity of separate but adjacent sheets of filter paper joined together adhesively at their edges to form a pleated accordion-like filter mass.

Preferably the adhesive connection between adjacent sheets of filter paper is a direct connection.

Alternatively, the adhesive connection between adjacent sheets of filter paper is indirect such, for example, as through the intermediary of intervening edge strips or formations.

An edge strip or formation may, inter alia, be a plastics moulding.

Spacers may be fitted between adjacent sheets of filter paper, and may be part of the edge strips.

The spacers may be united to form a spacer assembly.

Also according to another aspect of the present invention there is provided a method of forming a filter, especially but not exclusively a HEPA filter, the method comprising the steps of cutting filter paper sheet material

into a multiplicity of sheets of predetermined size, stacking the separate paper filter sheets together, and adhesively securing adjacent paper filter sheets together at their edges to form a pleated an accordian-like filter mass.

An alternative method of forming a of filter, according to this invention, is to fold the paper into pleated form as is currently done and then to apply to each folded edge a bead or line (continuous or interrupted) of adhesive, preferably thereafter applying pressure to the glued edges, thus provided a stronger, sharper edge to each pleat.

The adhesive may be applied to the paper filter sheets prior, or subsequent, to stacking.

The method may include the step of interposing between adjacent paper filter sheets intervening edge strips or formations to which the sheets are adhesively secured.

The adhesive employed may, inter alia, be a suitable hot melt adhesive.

As a result of the present invention there can be provided a HEPA filter, called a "micropleat" HEPA filter for example, which is provided with in-built edge strength by selection of the bonding adhesive used and, where provided, by the construction and configuration of the edge strips or formations.

According to an aspect of this invention, moreover, filter manufacture can be made easier and cheaper if the filter is made from stacked cut sheets of filter paper since no folding machinery is involved.

Embodiments of the present invention will now be described, by way of example, with reference to the accompany drawing, in which:-

Fig. 1 is an end elevation and a detail view of a "micropleat" HEPA filter;

Fig. 2 is a sectional side elevation and a detail view of part of an alternative construction of "micropleat" HEPA filter; and

Fig. 3 is a perspective view of a finished "micropleat" HEPA filter.

Referring to Fig. 1 a basic "micropleat" HEPA filter according to the present invention is constituted by separate cut sheets 10 of filter paper stacked together as indicated at 11 and edge bonded by a hot melt adhesive 12 for example to form a pleated accordion-like mass 13 (see Fig. 4) conveniently mounted in a supporting frame 14. The "sharpness" of the edges and the shape of the inter-sheet passages resulting from the adhesive bonds ensure an improved air flow characteristic through the filter compared with known HEPA filters.

In an alternative construction (see Fig. 2), sheets 15 of pre-cut and stacked filter paper, or selected adjacent ones thereof, are edge-adhered together through the intermediary of intervening edge strips or formations 16, say of moulded plastics constructions for example. Here again the adhesive employed may, inter alia, be a hot melt adhesive. Alternatively the edge strips or formations 16 are themselves formed of a hot melt adhesive. It is to be noted that the size and configuration of the edge strips or formations 16 can be selected to suit, for example, particular airflow conditions or assembly requirements of the filter mass and/or to improve the air flow characteristics of the filter.

Spacers (not shown) may be interposed between adjacent sheets or selected adjacent sheets. Such spacers may form part of the edge strips or formations 16 and/or may be interconnected to form a spacer unit.

By appropriate selection of the adhesive employed, and, where provided, selection of the construction and configuration of the edge strips or formations, there can be formed a "micropleat" HEPA filter having considerable edge strength and certainly improved edge strength compared with the traditional folded HEPA filters.

The fact that the filter is made from assembled cut paper sheet material simplifies the manufacture of HEPA

filters according to the present invention. Also by "building up" the filter from the separate, but adhesively bonded together sheets of filter paper, with or without the intervention of edge strips or formations and spacers or spacer assemblies, permits a strong, robust and dimensionally stable filter structure to be created which can be dimensionally compact while providing an improved airflow thus giving a high filtration performance.

An alternative HEPA filter is formed by folding a length or strip of filter paper into pleated accordion-like form as is currently done and then to apply to each folded edge a bead or line (continuous or interrupted) of adhesive. Thereafter pressure may be applied to the glued edges to provide a stronger, sharper edge to each pleat.

The HEPA filter may be in the form of a circular cartridge so that the filter paper stack is of annular configuration.

CLAIMS

1. A filter, especially but not exclusively a HEPA filter, comprising sheets of filter paper arranged in stack form with selected edges of adjacent sheets adhesively connected to form an accordion-like mass.

2. A filter, especially but not exclusively a HEPA filter, comprising a multiplicity of separate but adjacent sheets of filter paper joined together adhesively at their edges to form an accordion-like pleated mass.

3. A filter as claimed in claim 2, in which the adhesive connection between adjacent sheets of filter paper is a direct connection.

4. A filter as claimed in claim 2, in which the adhesive connection between adjacent sheets of filter paper is indirect.

5. A filter as claimed in claim 4, in which at least some adjacent sheets of filter paper are adhesively connected together through the intermediary of intervening edge strips or formations.

6. A filter as claimed in claim 5, in which the edge strips or formations are plastics mouldings or formed from a hot melt adhesive.

7. A filter as claimed in claim 5 or 6 comprising spacers between at least some adjacent sheets of filter paper.

8. A filter as claimed in claim 7 in which the spacers form part of the edge strips or formations.

9. A filter as claimed in claim 7 or 8, in which the spacers are interconnected so as to form a spacer unit.

10. A filter as claimed in claim 1 comprising a length or strip of paper folded into pleated form with each folded edge being provided with a strengthening bead or line of adhesive.

11. A filter as claimed in claim 10, in which the strengthening adhesive bead or line is of a continuous or interrupted nature.

12. A filter as claimed in any one of claims 1 to 11 the adhesive connections are by way of a hot melt adhesive.

13. A filter, especially but not exclusively a HEPA filter, substantially as hereinbefore described with reference to the accompanying drawing.

14. A method of forming a filter, especially but not exclusively a HEPA filter, the method comprising the steps of forming a stack of sheets of filter paper, and adhesively securing adjacent paper filter sheets together at selected edges to form a pleated accordion-like filter mass.

15. A method as claimed in claim 14, comprising the steps of cutting filter paper sheet material into a multiplicity of sheets of predetermined size, and stacking the separate paper filter sheets together.

16. A method as claimed in claim 14 comprising the step of folding length or strip of filter paper into pleated form to form the stack of paper filter sheets.

17. A method as claimed in any one of claims 4 to 16 comprising the step of applying the adhesive to the edges of the paper filter sheets prior to stacking.

18. A method as claimed in any one of claims 14 to 16, comprising the step of applying the adhesive to the edges of the paper filter sheets subsequent to stacking.

19. A method as claimed in any one of claims 14 to 18 comprising the step of locating between the edges of at least some adjacent sheets of filter paper edge strips or formations with adhesive connection between the edge strips or formations and the adjacent filter paper sheet edges.

20. A method as claimed in any one of claims 14 to 19 comprising the step of locating spacers between at least some of the adjacent sheets of filter paper.

21. A method as claimed in any one of claims 14 to 20 in which the adhesive connection is effected by means of hot melt adhesive.

22. A method of forming a filter, especially but not exclusively a HEPA filter, substantially as hereinbefore

described with reference to the accompanying drawing.

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